RETURN FLOW AS AFFECTED BY SPRINKLER AND FLOOD IRRIGATION

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Introduction

Water rights in the Sevier basin have become a highly complex and controversal subject. More surface water may have been appropriated than what is actually available in the system. Thus, lower users depend upon return flow from upper users to fulfill their water rights. If the upper users were to increase their consumptive use, so that they reduced the return flow, water to the lower users could be decreased.

The water users on the lower part of the Sevier River are concerned that if sprinkler expansion on the upper Sevier continues, their supply of water could be greatly reduced. In view of this fact, the lower users requested a study be made to determine what impact sprinklers would have on return flow.

The system chosen to be studied was City Creek which is a tributary to the Upper Sevier. City Creek Irrigation Co. owns 3/4 of the total flow for the irrigation of about 300 acres. The remainder is owned by the residents of Junction for the irrigation of lawns and gardens. City Creek Irrigation Co. has recently installed a sprinkler system on their lands. Part of the old flood system is still in contact, thus making a study between the two systems possible. Two 2½ acre test plots on the farm of Mr. Glade Jensen were chosen as test sites. This area was still able to utilize the flood system. The soil characteristics are such that the available water in a 5-foot root zone, is about 8 or 9 inches when the soil is at field capacity. The top layer is loam soil, the second layer is a very fine sandy loam, and the third layer is a sandy loam. Gravel streaks under the top soil are also common.

One of the test plots was irrigated as to simulate flood irrigation in the past. The other plot was sprinkler irrigated. The amount of water applied to each plot was measured and the efficiencies determined. From this data, the amount of water that was deeply percolated was then estimated. The description and results of the tests performed are as follows:

The type of tests made during the study were: soil-water tests made at most irrigations, cylinder infiltrometer tests, tests made to determine salt movement, and a seepage analysis to determine conveyance losses. These tests were to be performed as closely as possible to simulate conditions in the past. However, before the sprinkler system was installed, the flood irrigation system utilized a pond in which the water was stored during the night. Storing the water during the night enabled the irrigator to double the flow that he would have had otherwise. This larger flow would help to increase efficiency because the larger head would force the water over the land faster. As stated previously, City Creek Irrigation Co. owns only 3/4 of the total flow; however, to compensate for not being able to store the water, the full stream flow was diverted although the flow was not nearly as large as if it had been ponded during the night. Thus, the application efficiency determined during this study is probably lower than it would have been if the land had been irrigated under the old system.

Irrigation Tests

Seven tests were taken out of a total of eight flood irrigations. Each test consisted of measuring the soil moisture before (hereafter called dry holds) and after (hereafter called wet holes), the irrigation, and at three different locations throughout the field. The amount of water applied to the field was measured through a parshall flume and cipolletti weir. The flume consistently read about 5% more than the weir. The flume was bent and therefore, the weir was considered most accurate. The difference between the amount of water added to the soil and that applied was considered to be deep percolation, since only negligible runoff occured during the irrigations. The irrigations were commenced on June 8th and were completed August 23rd. The 3rd irrigation on July 2nd was the one not tested due to a misunderstanding of when it was to take place. The efficiency is defined by dividing the amount of water stored in the root zone by the amount applied to the field. The efficiencies ranged from 100% to 49% depending mainly on the water available and the amount of land irrigated. Table I shows the amount of water applied to the field, the amount stored in the root zone, and the efficiencies for each irrigation tested. Some questions may arise as to why more water appeared in the root zone than what was actually applied, for irrigations 1 and 8. Many sources of error are possible, such as contamination of soil samples, samples not taken in a truly representative area, etc. However, the errors are not great, less than 1% for number 1, and 8% for number 8, which is probably the highest error of the tests.

It is difficult to accurately measure the land irrigated. The top end of the field usually covered a wider strip of land than did the bottom. Also, the land at the top was usually better covered because of the greater head on the water. At the bottom of the field, some of the land was not covered because of the irregularities in the field. Gopher holes also made it difficult to measure the land irrigated. A hole may receive an an entire furrow stream and bring it 50 or so feet away from the rest of the irrigated area. Also, when the crop had full ground cover, it was difficult to tell what had been irrigated and what had not; and therefore, it was even more difficult to measure. These errors possibly could have been corrected by measuring an exact parcel of land, and then making sure that this area was irrigated. However, this could not be in keeping with the irrigation practices established by the farmers in the past. Also, the gopher holes and irregularities of the land would still have been a problem.

Representative areas were chosen to take the soil samples. Therefore, the tests after the irrigations may have not been in exactly the same spots as the ones before. The spot where the dry soil samples were taken before the irrigation may have received more or less water than the average area; and therefore, a different location was chosen for the soil samples after the irrigation. This may have introduced some error, but would be more accurate than taking both tests in the same location, if that location did not accurately represent the irrigated area. This is especially true at the lower part of the field.

An estimated parcel of land that was to be irrigated was idvided into three parts: top, middle, and bottom. Soil samples were obtained near the center of each part at depths of 6", 1', 2', 3', and 4'. About 12 hours after the irrigations, soil samples were again collected in each section at the corresponding depths as the samples taken before the irrigation. The moisture content of each sample was determined by drying at 105°C until no weight change occured. The difference between the dry and wet holes then indicated the amount of water added to the root zone during the irrigation. Tests were taken to determine the bulk density of the soil at different depths throughout the soil profile. The first 3 values average 1.3 when rounded off. The last five values averaged 1.4 when rounded off. These averaged values were the one that were used. The results are shown in Table II. This enabled the volume of water added to the root zone for each layer and each one-third section of land to be determined. The results of water added to the root zone for each irrigation are shown in figures 1 through 7. Each figure depicts the relative amount of water added to each third of the field (top, middle, and bottom). Each irrigation added the most water to the top part of the field and the least to the bottom, except for irrigation #3 in which the middle section showed the most water added. This could have been because the test after the irrigation may have been taken near a gopher hole which would have allowed more water to infiltrate than would normally.

The intake characteristic of the soil was found by performing cylinder infiltrometer tests. These results are in rather close agreement except for one which was placed near a roadway that must have been more compacted than the rest of the field. However, the others were very good. An equation was developed to predict accumulated intake as a function of time. The equation was then used to predict accumulated intake for the given irrigation time, and then compared with the actual intake at the top end of the field. In five out of seven recorded irrigations, as shown in Table III, the infiltration equation predicted more water than what the soil moisture tests indicated was added to the soil. This indicates that water was passed on through the root zone, and was lost to the plant; thereby corresponding to the lower efficiencies. For irrigations one and eight, the equation predicted less water added to the root zone than what was measured by the soil moisture test. Thus, showing that all of the water was added to the root zone which was applied to the field, thereby corresponding to the high efficiencies.

Evapotranspiration rates were estimated from daily recorded temperatures; the percent of sunshine was also estimated from daily local observations. A brief description of methods used to predict evapotranspiration and their results are shown in Table ~~III~~ IV. The potential seasonal evapotranspiration is more than what was applied at any one place by the flood irrigation system. The Blaney-Criddle is higher than the Jensen-Haise for the earlier months of the season, but averages out about the same. It was considered impractical to try to predict the actual transpiration due to the lack of soil-water data. Each section of irrigated land would have a different actual transpiration than another depending on when it was irrigated.

The number of acres that are irrigated with the 3/4 stream flow are about 300 acres. The total acreage for the flow is 426.8 acres. There are not any continuous stream flow records; however, based on observations this past summer, it appears that the flow is very inadequate. The total flow on June 8th at the head of the farm was about 1.5 c.f.s. This flow diminished to about 1.0 c.f.s. by the second of third irrigation and remained there throughout most of the season. Using an average of 1.25 c.f.s. for the 300 acres, evapotranspiration requirements for the months of May through September the water available would be about 12" leaving a deficit of 12".

Seepage Analysis

A seepage analysis was performed on October 29, 1976. The inflow was measured with a V-notched weir just after the 1st underground pipeline. The ditch then proceeded eastward to Highway 89. At the Highway, it turned south for approximately 300 feet then turned east again at the head of the Jensen's farm. The second weir was placed at the head of the Jensen farm. The total length of ditch tested was 1120 feet. Water was in the ditch for three days prior to the test.

When the water was returned to the canal after setting the weirs, the time was recorded for the initial head of water to go from the upper weir to the lower weir. The time recorded for the water to pass between the two weirs was 25 minutes. Therefore, the lower weir was read directly after the upper weir and then again 25 minutes after the reading of the upper weir. Presumably this second reading of the lower weir would account for changes in the quantity of flow. The results are as presented in Table ~~IV~~ V.

The flow varied throughout parts of the test. This may have increased the error, but would be partially accounted for in the "25 minute-lag reading." Variance of flow can be attributed to clogging of the canal. Leaves and ice accumulated at the entrances of the underground pipeline and caused the canal to pond water and & AT TIMES TO overflow. Since an underground pipeline was between the two weirs, additional errors may have developed. During readings 8 and 9, water was being ponded between the two weirs. This would decrease readings on the lower weir, thus decreasing the efficiency. If these readings are not used, the average seepage loss is changed from 92% to 95% which is probably more realistic. The same type of soil was not encountered throughout the entire length of canal tested. The rest of the canal consisted of more or less loam soil rather than of gravel. Therefore, it would not be feasible to extrapolate the 5% seepage loss throughout the rest of 5,000 - 6,000 feet of canal. Therefore, the seepage loss would be about 5% when the water was used to irrigate the Jensen farm and somewhere between 10 to 30% when the water uas used at the far end of the system.

Sprinkler Irrigation

AS STATED PREVIOUSLY table IV A V depicts the monthly total evapotranspiration for the Blaney-Criddle and Jensen-Haise. For the months of May through September, both methods predict 24" of evapotranspirtation. However, for the months of June through September the two methods show some discrepancy. Using the Jensen-Haise method, with a seasonal evapotranspiration of 24 inches, then subtracting May's evapotranspiration of 1 inch plus 1 inch of evaporation leaves a requirement of 22 inches for the last four growing months. During May the irrigation water would be used to bring the soil profile to field capacity, if fall irrigation and winter precipation had not brought the soil to field capacity before then. Flow during May would be higher than evapotranspiration requirements because of spring runofff, and also because of cool temperatures and early growth stages. Thus the last four growing months would be the critical water months. Considering the last four growing months as having an evapotranspiration requirements of 22 inches, daily average would be .18 inches and the two week average would 2.5 inches. THE SYSTEM WAS OPERATED 6 HOURS EVERY TWO WEEKS, THEREFORE APPLZN'L APPROXIMATELY 2.3 IN EVERY TWO WEEKS.

The City Creek system uses 3/16 X 1/8 inch double nozzles with 40 X 60 foot spacings and operates at about 40 psi. From Ames Irrigation Handbook the uniformity coefficient (Cu) can be determined and thus the water lost to deep percolation by the system. The calculation are as follows.

1. Typical profile "B" used page 5559
2. Effictive diameter = 80 feet reduced by 10% for average 10 mph wind = 72 feet.

3. Profile "B"

4. Spacing along lateral = 40 feet
   % dia = 40/72 = .56%

5. Spacing along main = 60 feet
   % dia = 60/72 = 83%
   From table V-11 page SSS-9
   % dia = 56%, Cu = 99%
   % dia = 83%, Cu = 68%
   Cu = .99 X .68 = 67% ≈ 70%

   <u>Page SSS-8</u>
   Max for any area = (T)(M)(3- 2Cu/100)
   (6)(.385)(3- 2(.7)) = 3.7"
   Min for any area = (T)(M)(2Cu/100 - 1)
   (6)(.385)(2[.7] - 1) = .9"
   Avg. Gross High ½ = (T)(M)(2 - Cu/100)
   (6)(.385)(2 - .7) = 3.0"
   Avg. Gross Low ½ = (T)(M)(Cu/100)
   (6)(.385)(.7) = 1.6"

Considering that 1/2 the irrigated area would receive an average of 3.0 inches, the low 1/2 recieves an average of 1.6 inches and the evaportranspration requirements of 2.5 inches, then 3.0 - 2.5 inches equals .5 inches would be deep percolated for half of the area irrigated or .25 inches for the entire area. Then .25/2.5 inches equals .10 or 10% of the irrigation water would be lost. Using the maximum and minimum application for any one area also gives a percolation loss of about 10%. These estimates do not include evaporation losses ~~for~~ from the sprinkles, however, the pressure was usually more than 40 psi, often as high as 45 psi. This increased pressure would apply about 3-6% more water which is the extimated evaporation loss for 24 hour sprinkling on a growing crop. (page SSS-6, Ames Irrigation Handbook).

Chemical Analysis

Chemical analysis were perfomed on the two plots at the beginning and end of the season. Tests were taken at the top and bottom of each plot at depths of 1, 2, 3 and 4 feet. However, for the first analysis the

1 and 2 foot and 3 and 4 foot tests were combined. These results are presented in Table ~~IV~~ VII.

The chemical consitutuents at the top end of both plots were relatively the same at the beginning and end of the growing season. The bottom of the sprinkler plot had a slight increase in everything tested except for chorides. The bottom portion of the flood system did have an increase in salts from the beginning to the end of the season. This would indicate that no leaching occured during the season. In fact according to the flood irrigation tests very little water was applied to the lower end of the plot (Fig. 1 - 8). Therefore, the chemical analysis does agree with the soil-water tests in that no leaching occured in that portion of the field. However, the increased salt concentrations may have been caused by a leak in the pipe in this portion of the field. Water may have leaked from the pipe, been evaportranspired, thus leaving salts in the root zone. In general it is assumed that the same amount of leaching occured in the root zone at the top of both plots. At the bottom end of the plots, no leaching occurred on the flood plot and maybe some limited leaching on the bottom of the sprinkler plot.

Conclusions

The results of the flood irrigation tests indicated an efficiency of about 80%. The sprinkler irrigation would be about 90%. Thus, the net difference between the two systems would be about 10%. Storing the water overnight, and then irrigating with a "double stream" would increase the flood irrigation efficiencies for the reasons noted previously. Seepage losses would be a maximum of 30% when irrigating the fields furthest from the diversion. The fields at the head of the system would lose around 5 to 7%. Therefore, the net difference between the two systems would be 15% at the upper end and 40% at the extreme lower end of the system. Averaging the seepage loss for the upper and lower fields, and adding the difference in efficiency for the two systems gives a total average difference of 25 to 30% in efficiency between these two systems.

Further investigation would be necessary to arrive at more accurate results and to determine if these figures could be applied to the entire 300 acre system. However, this is not feasible due to the fact that the old flood system is no longer in operation except for a very limited area, and it would be costly to restore. Even if it were to be completely restored, the restored system may not entirely simulate conditions in the past.

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TABLE I - Pertinent Data For Each Irrigation In Which Measurements Were Taken

Irrigation No.	Date	Area Irrigation	Water Applied to Field (ft^3)	Water Stored in Soil (ft^3)	Length of Time of Irrigation (min)	Efficiency (stored/amount)
1	June 3	70 X 480	12,690	12,713	187	100%
2	June 23	50 X 480	12,144	8,260	220	68%
3	July 2	- - - - - - - no	data - - - - - - - -			
4	July 12	30 X 480 18 X 350	12,963	9.960	210	77%
5	July 21	55 X 180	13,253	11,407	235	86%
6	July 29	34 X 120	14,586	7,074	221	49%
7	August 7	40 X 160	8,225	4,773	140	58%
8	August 23	35 X 480	7,813	8,482	155	100%
					Average - - - -	77%

TABLE II - Bulk Density Values Rested and Average Values Used

Depth	Average Value of Bulk Density	Value Used
surface	1.25	1.25
6"	1.34	1.30
1'	1.45	1.30
1½'	1.35	1.40
2'	1.46	1.40
2½'	no data	1.40
3'	1.39	1.40
3½'	1.32	1.40
4'	1.40	1.40

TABLE III - Comparison of Soil-water Added to Top of Field with Depth Predicted by Infiltration Equation for each Irrigation.

Irrigation	Soil-Water Added to Top of Plot (in)	Time (min)	Depth Predicted by Equation (in)	Efficiency (%)
1	10.81	187	8.30	100
2	6.25	220	9.13	68
3		------ no data ------		
4	7.38	150	7.40	77
5	9.47	235	9.47	86
6	8.84	221	9.15	49
7	4.75	140	7.12	58
8	9.62	155	7.53	100

TABLE ~~V~~ IV - Monthly Total Evapotranspiration for Blaney-Criddle

Junction, Utah 1976

BLANEY - CRIDDLE

Equation: $U = (\frac{t \times p}{100})k$

Monthly Total Values

Month	t	p	Etp
May	51	9.92	4.3
June	58	9.95	4.9
July	68	10.10	5.8
August	61	9.47	4.9
September	57	8.38	4.1
		Total =	24 inches

Where: t = mean monthly temperature in degrees fahrenheit.

p = percentage of day-time hours of the year, occuring during given month.

k = empirical coefficient; .85 for this case.

U = Etp (Evapotranspiration)

TABLE ~~VI~~ V - Monthly Total Evapotranspiration for Jensen-Haise

Junction, Utah 1976

JENSEN - HAISE

Equation: Etp = .015 (Ta - 25) Rs

To convert Etp to Inches: Etp = Etp/585(2.54)

Monthly Total Values

Month	Etp	
May	.96	+ 1.0 in. for soil evaporation
June	3.15	
July	8.21	
August	5.93	
September	4.93	
Total =	24 inches	

Where: Ta = average of daily maximum and minimum temperatures

Rs = (0.35 + 0.61 x %SS)Rso

Where: Rso = solar radiation for a cloudless day obtained from "Consumptive Use of Water and Irrigation Water Requirements".

%SS = fraction of daily possible sunshine obtained from "Water Requirements Manual for Irrigated Crops and Rainfed Agriculture," and local observations.

TABLE ~~IV~~ VI - Seepage Analysis Data

Reading Number	Upper Weir Time	Upper Weir CFS	Lower Weir Time	Lower Weir CFS	Efficiency (%)
1	5:32	1.39	6:20	1.39	100
2	6:32	1.41	6:40	1.37	97
			7:00	1.35	96
3	8:26	1.41	8:35	1.35	95
			8:55	1.35	95
4	9:00	1.41	9:15	1.39	98
			9:35	1.39	98
5	9:53	1.39	10:00	1.37	98
			10:20	1.37	98
6	10:33	1.43	10:42	1.39	97
			11:00	1.39	97
7	3:27	1.46	3:35	1.42	97
			3:52	1.42	97
8	7:48	.672	8:05	.683	80
			8:20	.539	80
9	9:03	1.20	9:10	.911	76
			9:28	.911	76
10	11:35	1.53	11:42	1.42	93
			12:00	1.42	93
11	12:20	1.43	12:25	1.33	92
			12:45	1.30	91
12	1:15	1.48	1:28	1.30	88
			1:40	1.39	94

AVERAGE - - - - - - - - - 92%

AVERAGE EXCLUDING READINGS #8 and #9 - - - - - - - - - 95%

TABLE VII Chemical Analysis for Flood and Sprinkler Plots at beginning and ending of the Growing Season

FLOOD IRRIGATION DATA

Top Portion of Plot

Date	Depth ft	ECe mmhos/cm	SP %	Na meq/l	Cl meq/l	TSS %	Moisture %
5/31/76	1 & 2	0.5	42	0.5	0.4	0.05	14.2
	3 & 4	0.4	32	0.4	0.3	0.03	8.5
10/19/76	1	0.6	36	0.4	0.3	0.05	15.5
	2	0.6	34	0.4	0.3	0.06	16.3
	3	0.5	30	0.3	0.2	0.05	14.1
	4	0.5	30	0.4	0.2	0.05	13.5

Bottom Portion of Plot

Date	Depth ft	ECe mmhos/cm	SP %	Na meq/l	Cl meq/l	TSS %	Moisture %
5/31/76	1 & 2	0.6	40	0.4	0.4	0.05	21.3
	3 & 4	0.4	36	0.4	0.4	0.04	21.4
10/19/76	1	1.3	34	0.6	0.3	0.06	26.1
	2	1.7	31	0.7	0.3	0.08	24.5
	3	1.9	31	0.8	0.3	0.09	23.5
	4	1.2	35	0.8	0.5	0.08	23.2

SPRINKLER IRRIGATION DATA

Top Portion of Plot

Date	Depth ft	ECe mmhos/cm	SP %	Na meq/l	Cl meq/l	TSS %	Moisture %
5/31/76	1 & 2	0.6	36	0.4	0.4	0.05	16.2
	3 & 4	0.7	40	0.5	1.0	0.07	21.7
10/19/76	1	0.7	37	0.5	0.2	0.06	5.7
	2	0.5	33	0.4	0.2	0.05	8.1
	3	0.7	33	0.4	0.5	0.05	7.2
	4	0.5	38	0.3	0.2	0.06	14.1

Bottom Portion of Plot

Date	Depth ft	ECe mmhos/cm	SP %	Na meq/l	Cl meq/l	TSS %	Moisture %
5/31/76	1 & 2	0.5	37	0.4	0.3	0.04	18.1
	3 & 4	0.4	35	0.4	0.4	0.05	19.4
10/19/76	1	1.2	38	0.7	0.4	0.06	14.5
	2	0.9	34	0.5	0.4	0.06	14.1
	3	0.9	30	0.5	0.4	0.06	15.9
	4	0.9	30	0.7	0.3	0.06	16.0

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6" layer .94 in 872 ft^3	6" layer .63 in 583 ft^3	6" layer .39 in 364 ft^3
6" layer 1.17 in 1092 ft^3	6" layer .63 in 583 ft^3	6" layer .16 in 140 ft^3
1' layer 1.18 in 1101 ft^3	1' layer 1.18 in 1101 ft^3	1' layer .84 in 392 ft^3
1' layer 2.52 in 2352 ft^3	1' layer .34 in 317 ft^3	
1' layer 2.90 in 2706 ft^3	1' layer 1.34 in 1250 ft^3	

FIGURE #1: Irrigation #1 - June 8, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

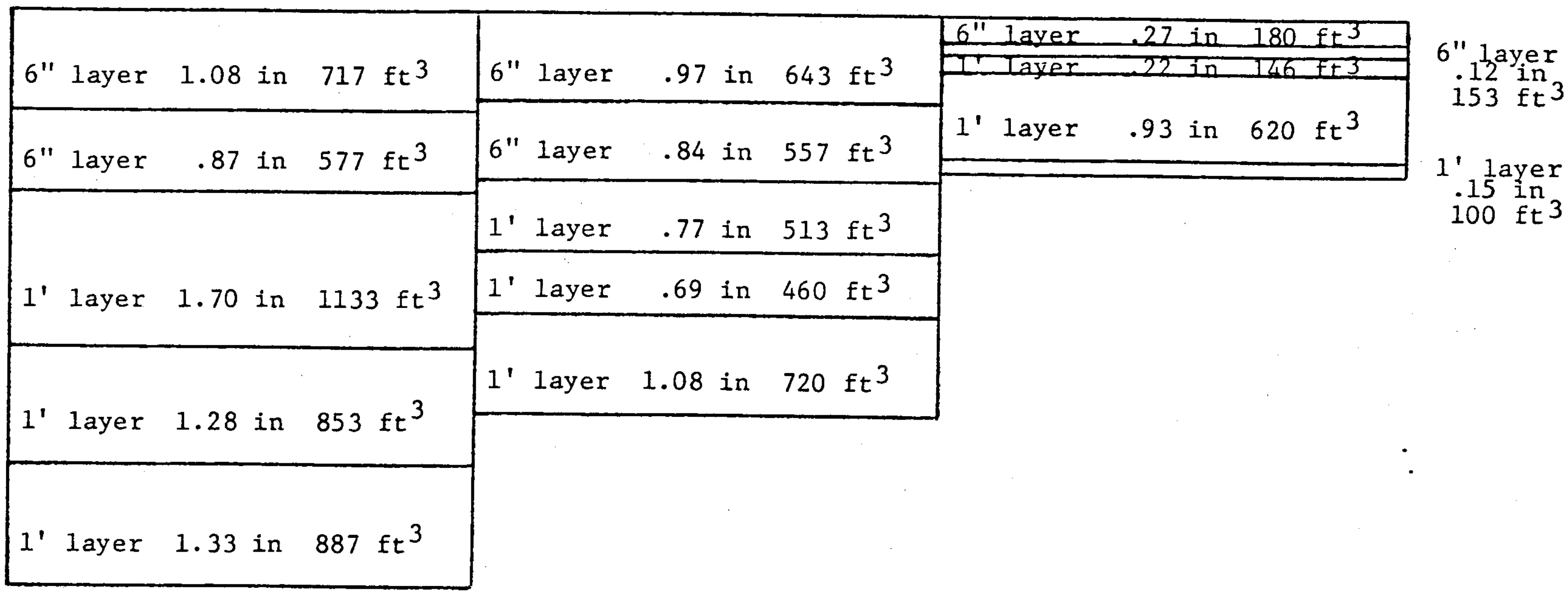

FIGURE #2: Irrigation #2 - June 23, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer 1.38 in 552 ft^3	6" layer 1.46 in 584 ft^3	6" layer 1.24 in 496 ft^3
6" layer .95 in 380 ft^3	6" layer 1.24 in 496 ft^3	6" layer .94 in 374 ft^3
1' layer 1.16 in 464 ft^3	1' layer 2.00 in 800 ft^3	1' layer 1.36 in 744 ft^3
1' layer .81 in 324 ft^3	1' layer 1.39 in 556 ft^3	1' layer .81 in 324 ft^3
1' layer .75 in 300 ft^3	1' layer 1.78 in 712 ft^3	

FIGURE #3a: Irrigation #4 - July 12, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer	1.16 inches	609 ft^3
6" layer	.84 inches	438 ft^3
1' layer	1.56 inches	819 ft^3
1' layer	.49 inches	257 ft^3
1' layer	1.38 inches	331 ft^3

FIGURE #3b: Irrigation #4 - July 12, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer 1.55 in 1122 ft^3	6" layer 1.59 in 1166 ft^3	6" layer 1.15 in 672 ft^3
6" layer 1.02 in 743 ft^3	6" layer .79 in 579 ft^3	6" layer .67 in 335 ft^3
1' layer 1.73 in 1269 ft^3	1' layer 1.95 in 1430 ft^3	1' layer 1.05 in 525 ft^3
1' layer 1.38 in 1012 ft^3	1' layer 1.63 in 1195 ft^3	1' layer .33 in 165 ft^3
1' layer 1.26 in 424 ft^3	1' layer .47 in 345 ft^3	

FIGURE #4: Irrigation #5 - July 21, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer 1.46 in 662 ft^3	6" layer 1.23 in 555 ft^3	6" layer .68 in 308 ft^3
6" layer .96 in 435 ft^3	6" layer 1.07 in 435 ft^3	6" layer .70 in 315 ft^3
1' layer 1.63 in 739 ft^3	1' layer 1.19 in 539 ft^3	1' layer .72 in 326 ft^3
1' layer 1.43 in 648 ft^3	1' layer .97 in 439 ft^3	
1' layer .94 in 426 ft^3	1' layer .30 in 136 ft^3	

FIGURE #5: Irrigation #6 - July 29, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer .36 in 192 ft^3	6" layer .53 in 280 ft^3	6" layer .50 in 267 ft^3
6" layer .32 in 171 ft^3	6" layer .58 in 307 ft^3	6" layer .34 in 179 ft^3
1' layer 1.16 in 619 ft^3	1' layer 1.18 in 629 ft^3	1' layer 1.01 in 539 ft^3
1' layer 1.19 in 635 ft^3	1' layer .20 in 107 ft^3	1' layer .55 in 293 ft^3
1' layer 1.04 in 555 ft^3		

FIGURE #6: Irrigation #7 - August 7, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.

6" layer 1.13 in 525 ft^3	6" layer 1.06 in 492 ft^3	6" layer .56 in 525 ft^3
6" layer .77 in 359 ft^3	6" layer 1.02 in 476 ft^3	6" layer .50 in 467 ft^3
1' layer 1.92 in 896 ft^3	1' layer 1.26 in 588 ft^3	1' layer .72 in 667 ft^3
1' layer 1.81 in 845 ft^3	1' layer 1.48 in 691 ft^3	1' layer .65 in 602 ft^3
1' layer 2.10 in 980 ft^3	1' layer .79 in 369 ft^3	

FIGURE #7: Irrigation #8 - August 23, 1976: Amount of water added to each 6" or 1' layer of soil. Inches represents depth added to each respective layer. Cubic feet represents total volume of water added to each respective layer.